

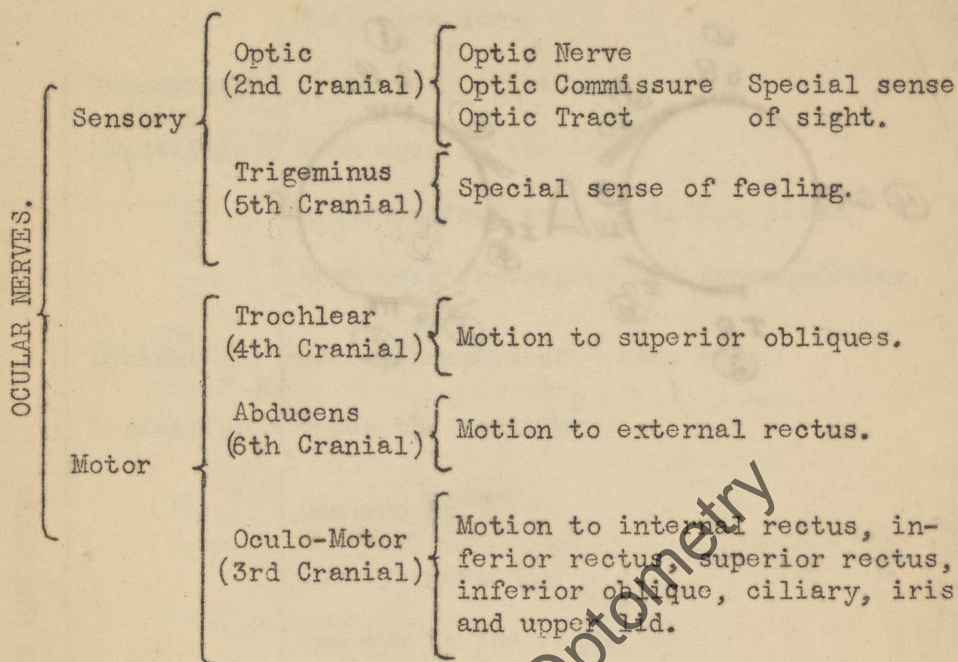
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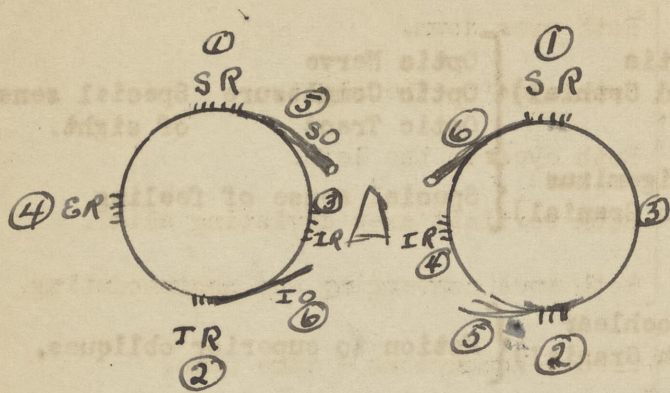
Northern Illinois College of Optometry

Muscles of the Eye

Study Outlines

54





EYE MOVEMENTS.

Homonymous (Like Positions)	{	Both eyes up.
		Both eyes down.
		Both eyes to the right.
		Both eyes to the left.
		Both vertical axes deviating alike.
		Both eyes converging and accommodating.
Derivation	{	Greek: homonymous = same name.
Definition	{	Under the same law.
Heteronymous (Unlike Positions)	{	One eye up.
		One eye down.
		One eye to the right.
		One eye to the left.
		One vertical axis deviating.
		Both eyes out.
		Both eyes in without accommodating.
Derivation	{	Greek: heteronymous = other name.
Definition	{	Under different laws.

General Rules for muscular work

1. To test duccion: Apex of prism over the muscle to be tested.
2. The eye is always turning (or has a tendency to turn) ^{opposite} to the direction of light displacement.
3. To measure the heterophorias: Base of the prism in the direction of light displacement.
4. To exercise muscle: Apex over the muscle to be strengthened.
5. For constant wear (prism correction) base over weak muscle.

Nomenclature of Ophthalmic prisms

1. Adducting or minus prism is one base out and increases convergence.
2. Abducting or plus prism is one base in and suppresses convergence.
3. Superducting prism is one base down.
4. Subducting prism is one base up.
5. A horizontal prism has its base apex line horizontal
i. e. either base in or out.
6. A vertical prism has its base apex line vertical
7. A relieving prism is one with its base over an inefficient muscle.
8. An adverse prism is one having its apex toward weak muscle causing an increased action of the latter
9. A combining prism causes the two images seen in a muscle test to be projected to the same point in space
10. A measuring prism is a better name for a combining prism.

DUCTIONS.	ADUCTION	Derivation	{ Latin: ad = towards + ducere = to lead.
		Definition	{ The power of the internal muscles to turn the eyes inward with <u>accommodation at rest.</u>
		Other name	{ Relative convergence.
		Test	{ Rule { Apex of the prism over the muscle to be tested. { Application { Apex in; base out.
		Amount	{ From 6 to 26 P.D. Normal average 24 P.D. *
	ABUCTION	Derivation	{ Latin: ab = away + ducere = to lead.
		Other name	{ Negative convergence. (<i>Really divergence</i>)
		Definition	{ The power of the external muscles to turn the eyes outward.
		Test	{ Rule { Apex of the prism over the muscle to be tested. { Application { Apex out; base in.
		Amount	{ From 4 to 9 P.D. Normal average 8 P.D.
	SUPRADUCTION	Derivation	{ Latin: supra = above + ducere = to lead.
		Definition	{ The power of the superior rectus to turn the eye up.
		Other names	{ sursumduction: superduction.
		Varieties	{ Right and left.
		Test	{ Rule { Apex of the prism over the muscle to be tested. { Application { Apex up; base down.
	INFRADUCTION	Amount	{ From 1 to 3 P.D. Normal average 2 P.D.
		Derivation	{ Latin: infra = beneath + ducere = to lead.
		Definition	{ The power of the inferior rectus to turn the eye down.
		Other names	{ Deorsumduction: subduction.
		Varieties	{ Right and left.
		Test	{ Rule { Apex of the prism over the muscle to be tested. { Application { Apex down; base up.
		Amount	{ From 1 to 3 P.D. Normal average 2 P.D.

Natural amplitude of convergence in a normal person is usually more than 30 P.D.

TESTING DUCTIONS.

General
procedure
for testing
all of the
ductions.

1. { Place the ametropic correction before the eyes.
2. { Have the patient seated at a distance of 6 meters from a small light.
3. { Place a weak prism before the eye apex over the muscle to be tested.
4. { Increase the power of the prism gradually until the patient reports diplopia.
5. { The strongest prism which the patient can fuse measures the duction.

Important
modification
in testing
adduction

1. { Put on ametropic correction.
2. { Place the light at the side of an illuminated test card.
3. { With every increase of prism ask the patient to read the test letters.
4. { The strongest prism which he can fuse, maintaining distinct vision measures the adduction.

Derivation { Greek: orthos = normal + phoros = tending.

Definition { Perfect binocular balance.

ORTHOPHORIA.

Test
to prove
Orthophoria

1. { Light at a distance of 6 meters.
2. { Cover the right eye with the blank disc.
3. { Back of it put the red glass.
4. { Place the double prism in a horizontal position before the left eye.
5. { The patient will see two white lights with a faint streak connecting them.
6. { By rotating the double prism, adjust the lights to a vertical position.
7. { Remove the blank disc, telling the patient that he should see a third light, which is red.
8. { If the three lights lie on the same vertical line there is no lateral imbalance.
9. { Cover the right eye with the blank disc.
10. { Turn the double prism at right angles to its former position.
11. { By rotating the double prism, adjust the lights to a horizontal position.
12. { Remove the blank disc, telling the patient that he should see a third light, which is red.
13. { If the three lights lie on the same horizontal line there is no vertical imbalance.

Deduction { Since the test shows neither lateral nor vertical imbalance, it proves orthophoria.

Tonicity Test

HETEROPHORIA.

Derivation { Greek: heteros = other + phoros = tendency.

Meaning { Other than normal tendency.

Definition { Imperfect binocular balance.

Insufficiency of external recti muscle

Esophoria: a tendency of the visual axes to deviate inward.

Insufficiency of internal recti muscle

Exophoria: a tendency of the visual axes to deviate outward.

Hyperphoria: a tendency of ~~one~~ ^{both} eyes to deviate above its mate.

Usual Varieties

Cataphoria: a tendency of ~~one~~ ^{both} eyes to deviate below its mate. *downward*

Hyperesophoria: a tendency of the visual axis of one eye to deviate upward and inward.

Hyperexophoria: a tendency of the visual axis of one eye to deviate upward and outward.

General Rule for Testing { In measuring heterophorias put the base of the prism in the direction of light displacement.

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TEST FOR ESOPHORIA.

Procedure

1. { Light at a distance of 6 m.
2. { Cover the right eye with the blank disc.
3. { Back of it put the red glass.
4. { Place the double prism in a horizontal position before the left eye.
5. { The patient will see two white lights.
6. { By rotating the double prism adjust the lights to a vertical position.
7. { Remove the blank disc, telling the patient that he should see a third light, which is red.
8. { The patient will see the red light displaced to the right.

Rule

{ The eye is deviating opposite to the direction in which the light appears displaced.

Proof

{ The right eye is turning inward.

Measurement

1. { Place weak prisms base out over either eye, increasing their strength until the three lights lie in the same vertical plane.
2. { The prism required to bring the three lights in the same vertical plane measures the amount of the esophoria.

I.
Indirect
Treatment

1. { Don't treat unless esophoria exceeds 5 P.D. or is associated with myopia.
2. { Correct the ametropia.
3. { Eye calisthenics.

Scope { We must strengthen the externi muscles. That means we must develop abduction.

Rule { Apex over the muscle to be strengthened.

Application { Base in.

II.
Prism
Exercise

1. { Small light at 6 meters.
2. { Place weak prisms, base in, over either eye increasing their strength until diplopia results.
3. { Have the patient close his eyes.
4. { Remove the prism.
5. { Repeat the entire process.
6. { Develop abduction until about 3 P.D. base in, can be fused.

Procedure

1. { Once a day.
2. { Just after meals.
3. { The exercise should last 5 to 10 minutes.

Time

III.
Correction
with Prism

Rule

{ For constant wear, when exercise fails, place the base of the prism over the weak muscle to rest it.

Application { Base out.

Amount

{ As a rule prescribe only $\frac{2}{3}$ of the full amount found in the test, placing half over each eye.

TEST FOR EXOPHORIA.

Procedure

1. { Light at a distance of 6 meters.
2. { Cover the right eye with the blank disc.
3. { Put the red glass back of it.
4. { Place the double prism in a horizontal position before the left eye.
5. { The patient will see two lights.
6. { By rotating the double prism adjust the lights to a vertical position.
7. { Remove the blank disc, telling the patient that he should see a third light which is red.
8. { The patient will see the red light displaced to the left.

Proof

{ The right eye is turning outward.

Measurement

{ Place weak prisms, base in, over either eye, increasing their strength until the three lights lie in the same vertical plane.

{ The prism required to bring the three lights in the same vertical plane, measures the amount of the exophoria.

I
Indirect
Treatment

1. {Don't treat unless exophoria exceeds 3 P.D. or is associated with hyperopia.
2. {Correct ametropia.
3. {Eye calisthenics.

Scope

{We must strengthen the interni muscles without altering accommodation; that means we must develop adduction.

Rule

{Apex over the muscle to be strengthened.

Application

{Base out.

II
Prism
Exercise

Procedure

1. {Small light at a distance of 6 meters by the side of an illuminated test chart.
{Place weak prisms, base out, over either eye, increasing
2. {their power until diplopia results.
3. {Have the patient close his eyes.
4. {Remove the prism.
5. {Repeat the entire process.
6. {Develop adduction until about 24 P.D. base out can be fused with accommodation at rest.
7. {If the letters of the test chart become blurred at any time during the exercise, remove the prism and start again with weak prisms.

Time

1. {Once a day.
2. {Just after meals.
3. {The exercise should last about 5 to 10 minutes.

Rule

{For constant wear, when exercise fails, place the base of the prism over the weak muscle to rest it.

III
Correction
with Prism

Application

{Base in.

Amount

{As a rule prescribe only $\frac{2}{3}$ of the full amount found in the test, placing half over each eye.

TEST FOR RIGHT HYPERPHORIA.

Procedure

1. { Light at a distance of 6 meters.
2. { Cover the right eye with the blank disc.
3. { Back of it put the red glass.
4. { Place the double prism in a vertical position before the left eye.
5. { The patient will see two white lights.
6. { By rotating the double prism, adjust the lights to a horizontal position.
7. { Remove the blank disc, telling the patient that he should see a third light, which is red.
8. { The patient will see the red light displaced down.

Proof

- { The right eye is turning up.

Measurement

1. { Place weak prisms base down over the right eye, increasing the strength until the three lights lie in the same horizontal plane.
2. { The prism required to bring the three lights in the same horizontal plane measures the amount of the right hyperphoria.

TREATMENT FOR RIGHT HYPERPHORIA.

I.
Indirect
Treatment

1. { Don't treat unless hyperphoria exceeds $1\frac{1}{2}$ P.D.
2. { Correct the ametropia.
3. { Eye calisthenics.

II.
Prism
Exercise

- | | |
|-------------|---|
| Scope | { We must strengthen the inferior rectus of the right eye and the superior rectus of the left eye. |
| Rule | { Apex over the muscle to be strengthened. |
| Application | { Base up over the right eye or base down over the left eye. |
| Procedure | 1. { Small light at 6 meters. |
| | 2. { Place weak prisms base up over the right eye or base down over the left eye, increasing their strength until diplopia results. |
| | 3. { Have the patient close his eyes. |
| | 4. { Remove the prism. |
| | 5. { Repeat the entire process. |
| | 6. { Develop infraduction or supraduction until about 3 P.D. can be fused. |
| Time | 1. { Once a day. |
| | 2. { Just after meals. |
| | 3. { The exercise should last from 3 to 5 minutes. |

III.
Correction
with Prism

- | | |
|-------------|---|
| Rule | { For constant wear, when exercise fails place the base of the prism over the weak muscle to rest it. |
| Application | { Base down over the right eye or base up over the left eye. |
| Amount | { As a rule, prescribe only $\frac{2}{3}$ of the full amount found in the test, placing half over each eye. |

TEST FOR LEFT HYPERPHORIA.

- | | | |
|------------------|----|---|
| Procedure | 1. | { Light at a distance of 6 meters. |
| | 2. | { Cover right eye with the blank disc. |
| | 3. | { Back of it put the red glass. |
| | 4. | { Place the double prism in a vertical position before the left eye. |
| | 5. | { The patient will see two white lights. |
| | 6. | { By rotating the double prism, adjust the lights to a horizontal position. |
| | 7. | { Remove the blank disc, telling the patient that he should see a third light, which is red. |
| | 8. | { The patient will see the red light displaced up. |
| Proof | | { The right eye is turning down, or the left eye is turning up. |
| Measure-
ment | 1. | { Place weak prism base up over the right eye, increasing their strength until the three lights lie in same horizontal plane. |
| | 2. | { The prism required to bring the three lights in the same horizontal plane, measures the amount of the left hyperphoria. |

TREATMENT FOR LEFT HYPERPHORIA.

I.
Indirect
Treatment

1. { Don't treat unless hyperphoria exceeds $1\frac{1}{2}$ P.D.
2. { Correct the ametropia.
3. { Eye calisthenics.

Scope

{ We must strengthen the inferior rectus of the left eye and the superior rectus of the right eye.

Rule

{ Apex over the muscle to be strengthened.

Procedure

1. { Small light at 6 meters.
Place weak prisms base down over the right eye or base up over the left eye, increasing their strength until diplopia results.
2. {
3. { Have the patient close his eyes.
4. { Remove the prism.
5. { Repeat the entire process.
6. { Develop infraduction or supraduction until about 3 P.D. can be fused.

Time

1. { Once a day.
2. { Just after meals.
3. { The exercise should last from 3 to 5 minutes.

III.
Correction
with Prism

Rule

{ For constant wear, when exercise fails, place base of prism over the weak muscle to rest it.

Application

{ Base up over the right eye or down over the left.

Amount

{ As a rule prescribe only $\frac{2}{3}$ of the full amount found in the test, placing half over each eye.

TESTING LATERAL IMBALANCE AT THE READING DISTANCE.

Procedure

1. { The fixation object should be a small dot on a plain card at a distance of about 13 inches.
2. { Cover the right eye with the blank disc.
3. { Place the double prism in a horizontal position before the left eye.
4. { The patient will see two dots.
5. { By rotating the double prism, adjust the dots to a vertical position.
6. { Remove the blank disc, telling the patient that he should see a third dot.
7. { If the three dots are on the same vertical line orthophoria at the reading distance is indicated.

How may the middle dot appear?

Two Cases

- A. { The patient sees (with the right eye) the middle dot displaced to the right.
- B. { The patient sees (with the right eye) the middle dot displaced to the left.

Proof

Case A.

The right eye is turning in and this condition is called esophoria at the near point. Indicates weak accommodation.

Case B.

The right eye is turning out and this condition is called exophoria at the near point. Indicates abundant accommodation.

Measurement

Case A.

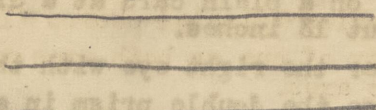
Place a weak prism base out over either eye, increasing the strength until the three dots lie on the same vertical line. The prism required to bring the three dots on the same vertical line measures the amount of the esophoria at the reading distance.

Case B.

Place a weak prism base in over either eye, increasing the strength until the three dots lie on the same vertical line. The prism required to bring the three dots on the same vertical line measures the amount of the exophoria at the reading distance.

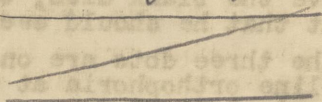
no Cyclophoria

A



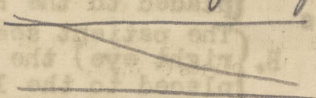
Plus cyclophoria

Δ



minus cyclophoria

Δ



Spasm of the inferior oblique or weak superior oblique causes plus cyclophoria

Spasm of the superior oblique or weak inferior oblique causes minus cyclophoria

Superior oblique turns the upper end of the vertical meridian nasalward.
Inferior oblique turns the upper end of the vertical meridian temporalward.

Therefore, the function of the obliques is to hold the vertical axis of the eyes parallel and hold the eyes forward in the orbit.

Derivation { Greek: kuklos = circle + phoreo = I bear.

Definition { A tendency of one or both eyes to rotate on the optic axes.

Test

1. { The fixation object should be a short line drawn on a card and placed before the patient at a distance of about 13 inches, with the line in a horizontal position.
2. { Cover the right eye with the blank disc.
3. { Place the double prism in a horizontal position before the left eye.
4. { The patient will see two lines.
5. { By rotating the double prism, adjust the lines to a horizontal position.
6. { Remove the blank disc.
7. { The patient should see a third line between the first two.
8. { If the lines are not parallel, cyclophoria is indicated.
9. { If the middle line inclines upward to the right it indicates that the vertical axes of the eyes incline toward each other at the bottom.
10. { If the middle line inclines upward to the left it indicates that the vertical axes incline toward each other at the top.

Treatment { This condition cannot be corrected by lenses or prisms. Constitutional treatment is the only possible measure.

Constitutional Treatment

1. All the rest possible.
2. Eye calisthenics.
3. From 9 to 10 hours sleep a day.
4. Good nerve building diet.
5. Fresh air and sunshine.

{ Ortho (normal) { Anatomic balance } Equal balance
 { Equalized tones }
 { Homo (same) { Ana = up
 { Kato = down
 { Dextra = right
 { Sinistra = left
 { Hetero (different) { Ero = in
 { Exo = out
 { Cyclo { + in at bottom
 { - out at bottom
 { Hyper { Right
 { Left

Esophoria { with the rule { with hyperopia
 { all under 5 P.D. need no treatment
 { Against the rule { with myopia
 { Treat all cases

Exophoria { With the rule { With myopia
 { all under 3 P.D. need no treatment
 { Against the rule { With hyperopia
 { Treat all cases

with the rule
 Esophoria under 5 P.D. { Esophoria usually corrects itself if Hyperopia is corrected in full.
 Esophoria under 3 P.D. { Esophoria usually corrects itself if myopia is corrected.

Against the rule
 Esophoria with myopia { Treat all cases
 Exophoria with hyperopia

STRABISMUS.

Derivation { Greek: strabos = oblique.

Meaning { Turn aside: crooked.

Definition { A condition in which the visual axis of one eye is deviated from the point of fixation.

Synonyms { Heterotropia.
Cross-eyes.
Squint.

Varieties {

- Convergent { (Esotropia) one eye or both deviate inward.
- Divergent { (Exotropia) one eye or both deviate outward.
- Vertical { (Hypertropia) one eye deviates upward.
- Concomitant { The squinting eye has freedom of movement and will follow the other.
- Paralytic { Opposite condition from concomitant.
- Alternating { The eyes take turns in fixing and squinting.
- Monolateral { Constant or one sided.
- Periodic { Intermittent: the squint manifests itself only occasionally.

Treatment of Heterophoria

- | | | | |
|---|----------|---|--------------------------|
| { | Indirect | { | Correct refractive error |
| | | { | Constitutional |
| { | Direct | { | Physical culture |
| | | { | Prism exercise |
| | | { | Prism correction |

LENS TREATMENT FOR CONVERGENT SQUINT.

1. { Cover the turning eye with the blank disc.
2. { Record the vision of the good eye.
3. { By means of a plus lens fog the eye so that the
largest letter on the chart appears blurred.
4. { Transfer the blank disc to the good eye.
5. { The turning eye will now be directed toward the
letter chart, unless the externus is paralyzed.
6. { Record the vision of the poor eye.
7. { By means of a plus lens fog the eye so that the
largest letter on the test chart appears blurred.
8. { By means of minus lenses unfog until the patient
can distinguish the letters in the 60 foot line.
9. { Substitute a single lens for the combination of
plus and minus.
10. { On removing the blank disc the better eye should
continue turning in and the poor eye fixing. If
not, use eye patch over better eye.
11. { Fit the glasses in temporary frame, using large
lenses.
12. { Order eye calisthenics.
13. { The eyes may straighten within a week, may require
several months or may never straighten without
prism method.

LENS TREATMENT WHEN EYE THAT CONVERGES
IS TOTALLY AMBLYOPIC.

1. { Cover the amblyopic eye with the blank disc.
2. { Record the vision of the good eye.
3. { By means of plus lenses fog the eye so that the largest letter on the chart will be blurred.
4. { By means of minus lenses unfog until the patient can distinguish the letters in the 60 foot line.
5. { Substitute a single lens for the combination of plus and minus.
6. { The same lens may be given to the other eye.
7. { Prescribe these glasses for treatment.
8. { These glasses, by relaxing the ciliary spasm, may cause the amblyopic eye to straighten.

LENS TREATMENT FOR
ALTERNATING SQUINT.

1. { When the eyes have equal vision fog both eyes equally to 20-60.
2. { Prescribe these glasses for treatment.
3. { Order eye calisthenics.
4. { The eyes may straighten in a week, may require months or may never straighten without prism method.

PRISM EXERCISE FOR CONVERGENT STRABISMUS.

Principles

1. { In his effort to ignore the false image the patient has lost all desire for single binocular vision.
2. { For this reason treatment glasses were unsuccessful.
3. { By means of prisms we must make single binocular vision possible.
4. { The prism, placed base out, must be of sufficient strength to displace light to the macula.
5. { After producing single binocular vision, it is possible to exercise the weak muscles.

Procedure

1. { Small light at a distance of 6 meters.
2. { Place prism base out, which produces single binocular vision.
3. { Neutralize this prism slowly by means of weak prisms base in over either eye, increasing their strength until diplopia results.
4. { Have the patient close his eyes.
5. { Remove the prism which you used base in. Repeat the entire process.
6. { Eventually the patient should be able to fuse the lights without the assistance of any prism.
7. { Continue the exercise with weak prisms base in increasing the strength until the patient can fuse from 6 to 8 P.D.
8. { The muscles will now be in perfect balance and cross eyes permanently corrected.
9. { Treatment glasses previously described should be worn between visits.

PRISM EXERCISE FOR DIVERGENT STRABISMUS.

Principles

1. { Fogging lenses must not be used in cases of divergent squint.
2. { By means of prisms we must make binocular vision possible.
3. { The prism base in must be of sufficient strength to displace the light to the macula.
4. { After producing single binocular vision it is possible to exersive the weak muscle.

Procedure

1. { Small light at a distance of 6 meters.
2. { Place the prism base in which produces single binocular vision.
3. { Neutralize this prism slowly by means of weak prisms base out over either eye, increasing strength until diplopia results.
4. { Have the patient close his eyes.
5. { Remove the prism which you used base out.
6. { Repeat the entire process.
7. { Eventually the patient should be able to fuse the lights without the assistance of any prism.
8. { Continue the exercise with weak prisms base out, increasing their strength until the patient can fuse from 20 to 30 P.D.
9. { The muscles will now be in perfect balance and the cross eyes permanently corrected.
10. { Wear ametropic correction between visits and after completion.

Prism exercise is of very little benefit in cases of vertical squint, but in some cases we can prescribe prisms for constant wear which will produce single binocular vision.

Test the vision of the eyes and find the ametropic correction.

Suppose the right eye is turning up.

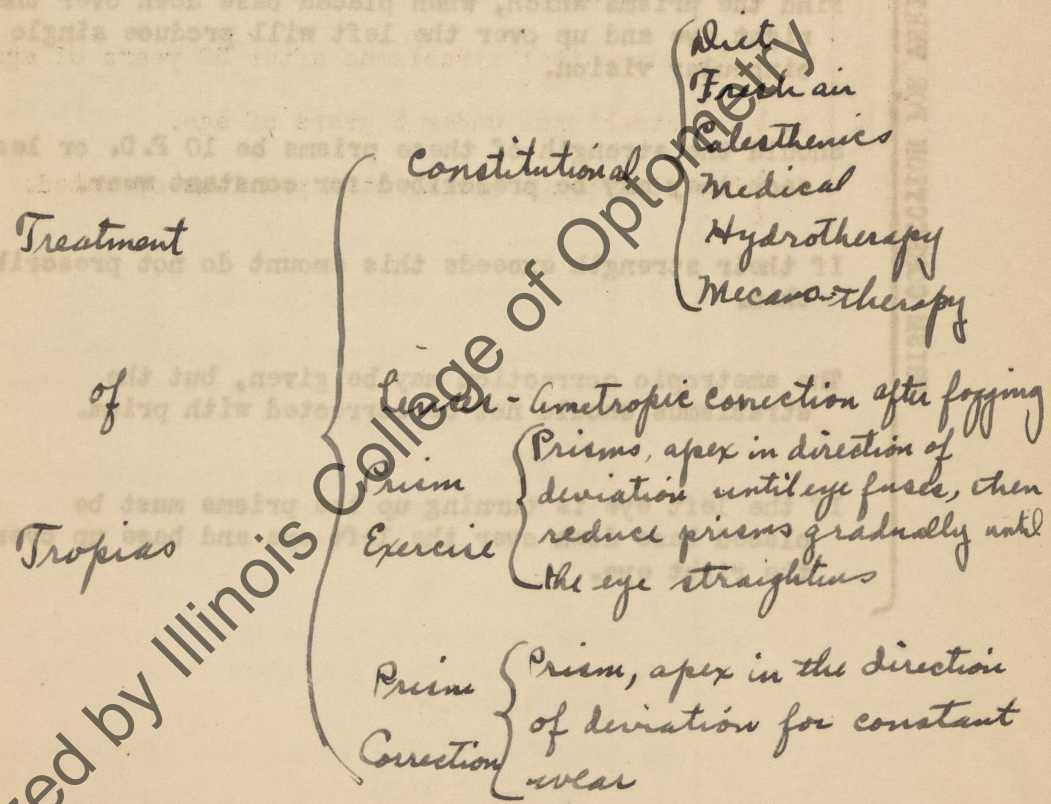
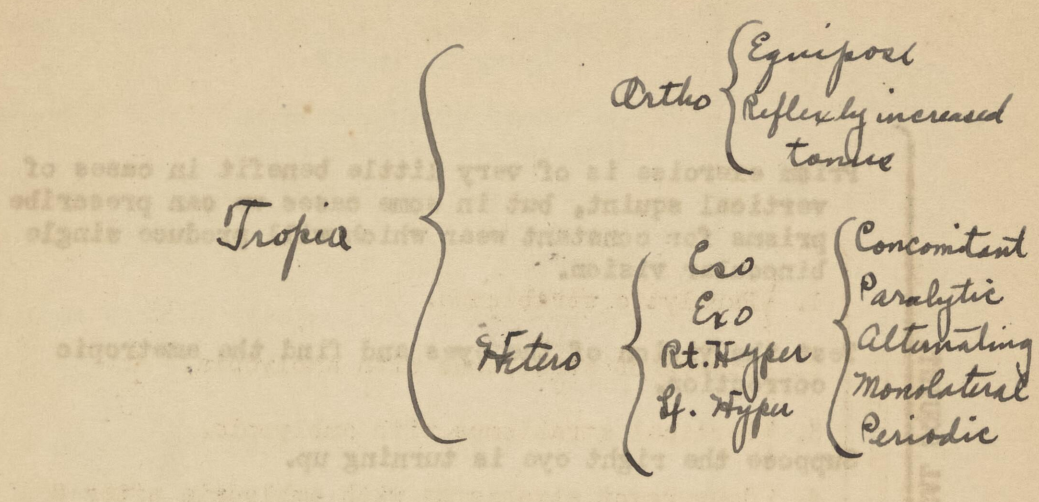
Find the prisms which, when placed base down over the right eye and up over the left will produce single binocular vision.

Should the strength of these prisms be 10 P.D. or less each they may be prescribed for constant wear.

If their strength exceeds this amount do not prescribe them.

The ametropic correction may be given, but the strabismus should not be corrected with prism.

If the left eye is turning up the prisms must be placed base down over the left eye and base up over the right eye.



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STRABISMUS WHICH IT IS USELESS TO
ATTEMPT TO STRAIGHTEN.

1. { Paralytic strabismus.
2. { Divergent strabismus with amblyopia.
3. { Vertical strabismus with amblyopia.
4. { Convergent strabismus with amblyopia after 8
years of age.
5. { Any congenital strabismus after 30 years of age.
6. { Any strabismus under 3 years of age.
7. { Any strabismus having been previously operated.

APPENDIX.

FACTS OF CHIEF IMPORTANCE TO ONE WHO SEEKS TO
PRACTICE MUSCLE WORK INTELLIGENTLY.

- First: Oculistics, or ocular gymnastics, are beneficial to all eyes, regardless of their state of balance, and if employed intelligently will contribute greatly toward the maintenance of efficient, comfortable vision.
- Second: In any case of imbalance "with the rule" the ametropia should be corrected in full and oculistics employed for all muscles alike.
- Third: In a case of imbalance "against the rule" the ametropia should have a slight undercorrection for a time, while oculistics are employed, stressing particularly an exercise of the ductions of the weaker muscles.
- Fourth: Abnormal imbalance at near, not revealed at infinity, may be benefited by general oculistics, together with attention to general health and possibly special correction at the reading distance.
- Fifth: Vertical imbalance and all cases of exophoria which do not respond to treatment, should be corrected with prism lenses.
- Sixth: All cases where suspensopia is suspected and most cases of abnormal imbalance at the near point, should have stereoscopic training.
- Seventh: As our final and most important rule, we would say: Beware of radicalism. In the words of Pope: "Be not the first by whom the new are tried, nor yet the last to lay the old aside."

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